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ABSTRACT

The lesson plans were designed to provide the practicing applied biological and agricultural occupations teacher with a series of units setting down a basic foundation in Environmental Education. Nine lesson plans cover (1) ecosystems and agriculture, (2) biotic communities and food chains, (3) energy and nutrient flow, (4) land use and supply, (5) population distribution and growth, (6) the energy crisis, (7) natural resources, (8) food production and supplies, and (9) current events concerning our ecological system. Each unit provides an introduction, statement of purpose, objective, the presentation, suggested activities, aids, and bibliography. The units are designed for use at the ninth and tenth grade levels. (MS)

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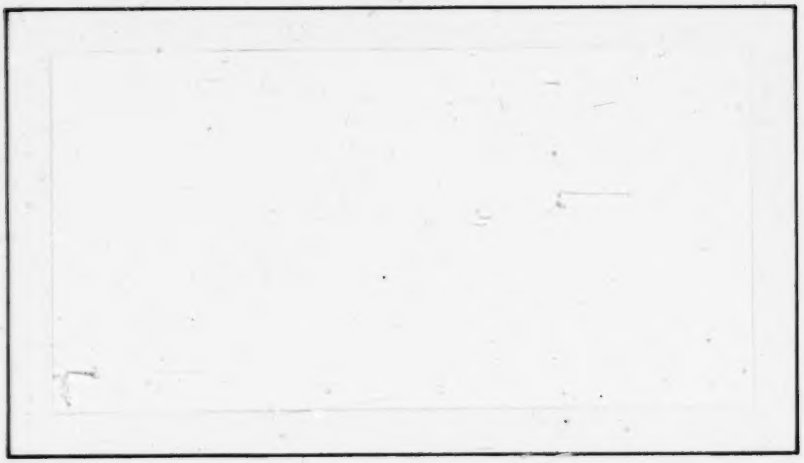

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TEACHING MATERIALS FOR ENVIRONMENTAL RELATED COURSES IN AGRICULTURE OCCUPATIONS PROGRAMS

Kermit B. Bohning and
Dr. Thomas R. Stitt

Series No. 101

July, 1973

Agricultural Industries

Southern Illinois University

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Foreword

Ecology, Environment and Conservation are all terms which are currently popular. The public awareness has moved into action with the Environmental Protection Act. These combinations of social, economical and political pressures have opened new areas of instruction for the practicing teacher. The Applied Biological and Agricultural Occupations teacher is being encouraged and in many cases expected to teach an Environmental Education component in his existing program.

Although well prepared in conservation and the production agriculture related areas, many teachers are unprepared to teach a quality basic Environmental Education program.

The lesson plans were structured to provide the practicing teacher with a series of lesson plans which provide the basic foundation in Environmental Education to be incorporated into the Applied Biological and Agricultural Occupations Curriculia. The lesson plans encompass the basic areas of Ecosystems, Food Chains, Energy and Nutrient Flow, Land Use, Population, Energy and Natural Resources. They are designed as introductory units at the 9th and 10th grade levels. Each unit provides a specific purpose and measurable objectives. New environmentally related terms are defined. The units include sufficient technical information to teach the unit with transparency masters for specific units.

The teacher will need to carefully evaluate the total curriculum to determine the optimum time for inclusion of the units. Transitional units will need to be developed to insure continuity into selected technical Applied Biological and Agricultural Occupations areas.

These units have been reviewed by practicing teachers and field tested with students in summer camps. The results of those evaluations were positive, and detailed information is included in a research paper entitled Development of Teaching Materials for Environmental Related Courses in Applied Biological and Agricultural Occupations, By Kermit Bohning, Department of Agricultural Industries, Southern Illinois University, Carbondale, Illinois.

UNIT: The Ecological System

LESSON: Ecosystems and Agriculture

INTRODUCTION:

Man's influence on his surroundings has created many problems. Some of these can never be solved, others can be eliminated. Every person has a role to play in solving these problems. Agriculture plays a big part in the overall ecological system.

PURPOSE:

To introduce the topics of ecology and the environment and the major problem areas. Also to develop an understanding of the concept of the ecosystem.

OBJECTIVES:

The student will be able to:

1. Define the terms environment, ecology, and ecosystem.
2. Discuss the parts of an ecosystem.
3. Discuss agriculture's role in ecosystems and the environment.

PRESENTATION:

What is the environment?

The natural resources of the earth and their surroundings. (Discuss with the class)

What is ecology?

The relationships and interactions between organisms and themselves and their environment. Man is an important part of these relationships and contributes a great deal of influence.

What are some of the components of our environment and how have they been influenced by man?

1. Air: pollution by man

2. Water: pollution by man

3. Soil: man has allowed some of our soil to erode and deteriorate. He has also worked to improve and maintain the soils of many areas.

4. Wildlife: many species have been exterminated and endangered by man's activities. Many steps are now being taken to preserve and provide for our wildlife.

5. Forests: man has often abused our forests and the supplies have decreased. Good management can provide better forests and their use.

6. Minerals: the use of minerals has been a wasteful and rapid depletion process by man. Good management is needed.

There are also some other problem areas. What are some of them and why are they problems? How is agriculture involved?

Energy: this nation is beginning to consume energy faster than it can supply it; about 32% of the world's energy consumption. Problems are most serious in oil and natural gas supplies. Adequate supplies of electrical power also plague many areas of the country. Agriculture uses large supplies of energy.

Population: the population of the world continues to grow at a rapid pace. This means more food will have to be produced and more houses built. Agriculture will be called upon to provide this food on less acres.

Waste: disposal of all forms of wastes is rapidly becoming a serious problem. Cities are unable to dispose of their garbage and sewage adequately. Animal wastes can pollute streams just as sewage does.

Chemicals and Fertilizers: these have enabled agriculture to increase production. But there are also problems of pollution and residues which can be harmful.

Noise: as cities become more industrialized there is a problem of increased levels of noise.

Many of these problems interact with each other and are causes of still more problems. Deciding what level these should be maintained at and how to solve them is a never ending task.

What is an ecosystem?

An ecosystem is the physical environment and the living organisms which inhabit it.

It may be very small, such as an aquarium, or as large as the total biosphere; that part of the earth on which life exists. (Transparency 1)

The non-living parts of an ecosystem include: oxygen, carbon dioxide, heat, light, water, soil, and minerals.

The living organisms may be divided into three groups:

1. Producers: the green plants that are capable of fixing light energy
2. Consumers: the organisms which eat the green plants
3. Decomposers: the microorganisms which break down organic matter to release nutrients into the system

What are some examples of ecosystems?

forests, a field, ponds, and meadows

Give some examples of each of the living organisms which might be found in a forest ecosystem.

Producers: trees, shrubs, flowers, moss, forest litter

Consumers: insects, rabbits, woodchucks, deer, man

Decomposers: bacteria, fungi, soil microorganisms

Agriculture has two main goals:

1. to maximize the green plants (producers) and thus increase the amount available to the consumers, including man
2. to make use of many of the consumers for food

These green plants include the grain crops of wheat, corn, soybeans, and oats which man eats himself and feeds to consumers. They also include vegetable crops which man eats mainly and forage crops fed primarily to animals.

Man raises and uses these consumers for food and milk. They include swine, beef, and dairy cattle, sheep, and poultry. To do this agriculture increases production by:

1. providing nutrients which crops remove
2. eliminating unwanted plants - weeds compete for nutrients, water, and sunlight
3. controlling unwanted organisms - insects, rodents, birds. Pesticides, cultivation, and biological control are methods used.
4. increasing efficiency

There are many agricultural practices involved in the above list which can affect our environment. With good management and practices these are held to a minimum.

What are some of the specific agricultural problem areas?

1. animal wastes and odors - domestic animals in the U.S. produce wastes equal to two billion humans.
2. crop residues
3. pesticides
4. fertilizer runoff
5. chemicals
6. soil erosion - four billion tons of sediment are washed into U.S. streams every year.

The environment includes everything that surrounds us, including man and his effects. It is a source of resources that satisfy our needs. These resources have to be properly managed and cared for.

CLASS ACTIVITY:

Discuss how agricultural practices affect the natural balance of an ecosystem.

SUMMARY:

Definitions of environment, ecology, and ecosystems

The classification of living organisms

Agriculture's role

Agricultural problem areas

SUGGESTED TEACHING AIDS:

Transparencies:

1. Ecosystem diagram
2. Examples of ecosystems
3. Definitions

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ECOSYSTEM

NON-LIVING

O_2

CO_2

HEAT

LIGHT

WATER

SOIL

MINERALS

LIVING ORGANISMS

PRODUCERS
CONSUMERS
DECOMPOSERS

UNIT: The Ecological System

LESSON: Biotic Communities and Food Chains

INTRODUCTION:

The plants and animals which inhabit a common area affect each other and interact. The characteristics of these plants and animals are determined somewhat by their natural surroundings. Before man's influence they lived in near perfect balance, affected primarily by natural events. Now many other things influence them.

PURPOSE:

To develop an understanding of the biotic communities and their interactions, and the concepts of food chains and food webs.

OBJECTIVES:

The student will be able to:

1. Define and describe the terms biotic community and biotic succession as discussed in class.
2. Name and discuss four major biotic regions.
3. Define and name examples of herbivores and carnivores.
4. Describe what a food chain is and how it differs from a food web.

PRESENTATION:

What is a biotic community?

A group of plants and animals inhabiting a common area and having effects upon one another.

Biotic succession -

This is a sequence of biotic communities which tend to replace each other over time if undisturbed. This involves a replacement and change in the types of plants and along with this a change in the types of animals dependent on the plants.

An example:

Plants often invade bare areas and are eventually replaced by more plants. This may take place on bare rock, sand, exposed river bottoms, and in water.

A pond or lake undisturbed will be invaded by aquatic plants. Eventually these are replaced by partially submerged reeds and rushes. These are replaced by grasses as soil materials are washed in adding to the dead plant materials.

If this process is undisturbed, the lake will turn into a pond, then into a marsh, the marsh to a meadow, and to a forest. (Transparency 2)

What would the process be like if starting with bare sand?

1. small watery plants
2. beach grass sparsely populated
3. mat forming grasses and herbs
4. scrub bushes and taller grasses
5. some small pine trees and advanced grasses
6. intermittent forest - pine and softwood
7. dense fir and spruce

Another form of succession occurs when something wipes out the vegetation, such as a fire, but the soil is already available. First the forest is replaced by weeds, these by shrubs, these by various trees, and eventually by the original species of trees.

There are various types of major biotic regions in the world. What affects their characteristics?

temperature, precipitation, soil types, man, and topography

What are some of the major regions and some characteristics of each?

Tundra -

low temperatures, short summers

soil surface thaws in summer, but there is a layer below of permanent frost called permafrost.

plants are low growing so the snow protects them in winter. They complete growing cycles during the short summers.

many animals migrate here in the summer.

spasely populated areas

Conifer Forest Area -

This area lies south of the tundra.

Slightly warmer and heavy precipitation.

Trees are mostly fir and spruce.

Permafrost goes out in the summer.

Sparsely populated; many seasonal animals.

Deciduous Forest -

Trees are oak, maple, hickory, or other hardwoods.

Well distributed precipitation.

Warm, humid summers; cold winters with heavy snowfall.

Many of these areas have been cleared for farming.

Grasslands -

Found between forests and desert regions.

Lower rainfall, erratic wet and dry spells.

Grasses are dominate, especially tall grasses.

Dark topsoil rich in organic matter.

Grazing animals.

Deserts -

Dry areas.

Sagebrush, catus; sparse vegetation.

Plants and animals adapted to dryness.

Soils can be fertile, but is lack of water.

Tropical Forests -

Dense vegetation, wet, humid.

Savanna -

Scattered trees and shrubs in the grassland.

Groves of trees mixed in grassland areas.

Much of this has been a result of man's influence.

Water Areas -

Covers 70% of the earth.

Plants limited often by access to sunlight.

Each of these major regions have certain climatic conditions. In response to these and to the topography of the land the plant life has adapted to the area. Along with this, certain types of wildlife are found in each region, again dependent in part upon the characteristics of the region. These characteristics affect the type and form of the food chains found there.

What is a food chain?

This is the passing of energy as food from one level to another in an ecosystem.

Give some examples -

Shrubs are eaten by deer which are eaten by a mountain lion.

Grass is eaten by rabbits which are eaten by wolves

What are some others?

What are herbivores and carnivores?

Herbivores eat green plants.

Primary carnivores eat herbivores.

Secondary carnivores eat primary carnivores.

Which one of these categories does man fall into? Why?

Man falls into all three. Man eats green plants, he eats herbivores (cattle), and sometimes he eats primary carnivores (bear).

What are some examples of each?

herbivores: rabbits, deer, moose, bison, birds, man

carnivores: wolves, mountain lion, foxes, man, spiders

Usually these food chains are interwoven into each other and form food webs.

Make an example of a food web. (Transparency 3)

The total number of producers in a community must be much larger than the consumers. This is necessary in order to provide enough food for the consumers and still be able to maintain themselves. The same concept holds true as we move up the ladder of consumers. Thus the position of the species in a food chain will determine the size of its population in the community. Another determining factor will be the physical size of the organism.

(Discuss these ideas with the class.)

CLASS ACTIVITY:

If we had a meadow with rabbits in it which coyotes fed on, what type of populations of grass, rabbits, and coyotes would we have?

What would be the effect on the meadow and the coyote population if man came in and killed the rabbits?

What if the coyotes all died?

SUMMARY:

Biotic Community

Biotic Succession

Major Biotic Regions

Food Chains

Herbivores and Carnivores

Food Web

SUGGESTED TEACHING AIDS:

Transparencies of -

1. Biotic succession examples
2. Major Biotic regions
3. Food chains and food webs

Slides of -

1. Biotic succession procedure
2. Major Biotic regions

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1. Boggess, William R., "The Ecological System", Agriculture and the Ecological System, Urbana: University of Illinois, 1970.
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BIOTIC SUCCESSION

1. LAKE

   AQUATIC PLANTS INVADE

2. POND

   REEDS

3. MARSH

   SOIL WASHES IN

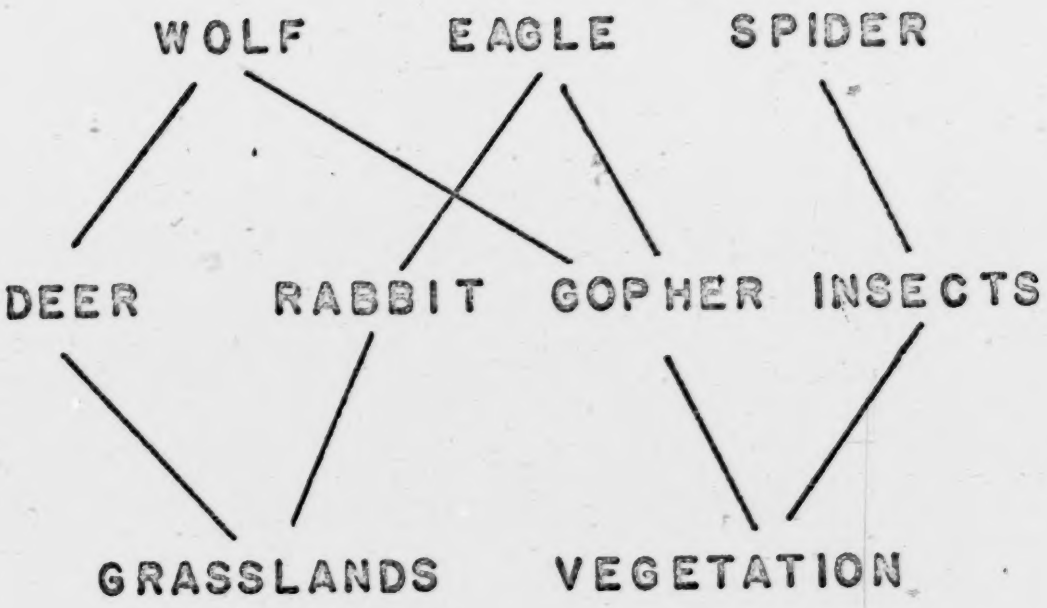
   DEAD PLANT BUILD UP

   GRASSES

4. MEADOW

5. FOREST

FOOD WEB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SPIDER
DEER
RABBIT
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INSECTS
GRASSLANDS
VEGETATION
SUNLIGHT
SOIL
WATER

UNIT: The Ecological System

LESSON: Energy and Nutrient Flow

INTRODUCTION:

All living things are dependent upon a source of energy to survive. The basic building blocks of all living things are the chemicals or nutrients which organisms are built from. Without a supply of energy or nutrients, living organisms can not survive.

PURPOSE:

To develop an understanding of the concepts of energy flow and nutrient flow and the importance of each in an ecosystem.

OBJECTIVES:

The student will be able to:

1. Define and describe the concept of energy flow.
2. Define and describe the concept of nutrient flow.
3. Discuss the difference between nutrient flow in a balanced, natural ecosystem and today's biosphere.

PRESENTATION:

What is the source of energy in an ecosystem?

All energy originates from the sun. However, only the green plants can make use of the sunlight to synthesize food directly.

How are plants able to do this?

The chlorophyll in their cells do this by a process known as photosynthesis.

Explain photosynthesis:

Light energy is used to build plant food (glucose) from carbon dioxide in the air and water. With other nutrients from the soil; proteins, carbohydrates, fats, and vitamins are made. These are the basic materials which animals must have.

Much of the sunlight which reaches the earth is never fixed by plants. Much of it is reflected or radiated back into space by the earth.

Of the total incoming sunlight, approximately 42 percent of it is reflected back - 33 percent by the clouds and 9 percent from dust. Another 10 percent is absorbed, scattered, or reflected by the gases, water, vapor, and particles in the atmosphere. This leaves less than one-half (48 percent) which reaches the earth's surface.[3] On cloudy days even less will reach the earth's surface. The type of surface will also affect how much is absorbed and how much is reflected by a certain area.

The oceans and forests absorb a large amount of the energy which is fixed. Only about 5 percent of the total is fixed by agricultural land.

The transfer of energy is far from 100 percent efficient.

What do we mean by this?

As energy is passed from one form to another some of it is lost each time. Plants often convert only 1 percent of the total energy available. Of this the herbivore loses some when it eats the plant, much of it in the form of heat energy. The same thing happens when the herbivore is eaten by a carnivore. The farther down the transfer, the smaller the amount of energy being passed on. Of 10,000 calories of sunlight striking down on green plants, a carnivore may only retain two. Thus the concept of energy transfer enters into the ecosystem. (Transparency 4)

What is the determining factor in the number of animals found in a given ecosystem?

The amount of energy available in green plants and how efficiently they can convert it is a determining factor. This will also hold true for the amount of green plants which are available.

As ecosystems have developed they have become more capable of storing energy. What are some of these stored energies?

Meat - the energy may have been first stored in plants up to several years earlier when the animals ate them.

Timber - this energy may have been stored from a hundred years earlier.

Coal and Oil - these forms of energy are thousands of years old.

As can be seen, the flow of energy is in one direction, never returning to previous sources. It is said to be non-cyclic.

Along with a source of energy there must also be a source of the basic nutrients. What are some of them?

Nitrogen, carbon, oxygen, phosphorus, pottassium, sulfur, zinc, calcium, and iron.

Where do plants obtain these nutrients?

Mostly from the soil with a few available from the air.

The flow of nutrients is cyclic, meaning that it is continuous and that it renews itself. In what ways are these nutrients returned to the soil in a natural ecosystem?

Plants die and decay.

Urine and droppings of animals.

Animals which die

What is leaching?

This is the washing and movement of nutrients through the soil as water moves downward.

How are these nutrients replaced in a natural ecosystem?

By the slow weathering and release of minerals and nutrients from the rocks.

If the flow of nutrients is cyclic, why must we use fertilizers on our crops?

The crops that man raises are removed from the soil and are used for food for himself and livestock. Therefore, the nutrients do not return to the soil through the decay of the plants. Some of the nutrients are returned through crop residues and animal wastes. Over the years the soil has been depleted of enough nutrients that it can not begin to grow the high yields of today without fertilizer.

Many of the major nutrients have their own typical cycles. Examples of these are the nitrogen, carbon, and sulfur cycles. (Transparency 5)

If we are removing nutrients from the soil in the form of crops, where do these nutrients end up?

Many of the nutrients end up in the streams and lakes from the sewage of the cities and some from the feedlot runoff. This is because most of the crops end up in the cities as food products. These nutrients will eventually reach the sea. (Transparency 6)

How can these nutrients be removed?

1. By spreading sewage and manure back on the land.
2. Returning processing wastes to the land.
3. Filtering nutrients from the sewage.
4. Farming the seas.
5. Recovering the nutrients from the oceans.

All of these have potential, but there are many problems involved: economical, health, and technological.

CLASS ACTIVITY:

Lets build a diagram of the energy flow and nutrient flow in a natural ecosystem.

The three main ingredients are what?

sunlight = energy soil and rainfall = nutrients

These go to the green plants which supply energy and nutrients to herbivores and decay organisms. This occurs at each step to the last carnivore.

Remember energy is lost at each step. Nutrients are returned to the green plants by the soil which is restored through the activity of the decay organisms. (Transparency 7)

SUMMARY:

Essential Ingredients: Energy and Nutrients

Energy Flow

Nutrient Flow

Returning nutrients to soil

Energy Loss

Nutrient Loss

SUGGESTED TEACHING AIDS:

Transparencies:

1. Where sunlight goes when it reaches the earth.
2. Energy Flow
3. Nutrient flow in a natural ecosystem.
4. Nutrient flow in today's biosphere.

Slides:

1. A series portraying the flow of nutrients from the soil to the oceans.

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1. Boggess, William R., "The Ecological System", Agriculture and Ecological System, Urbana: University of Illinois, 1970.
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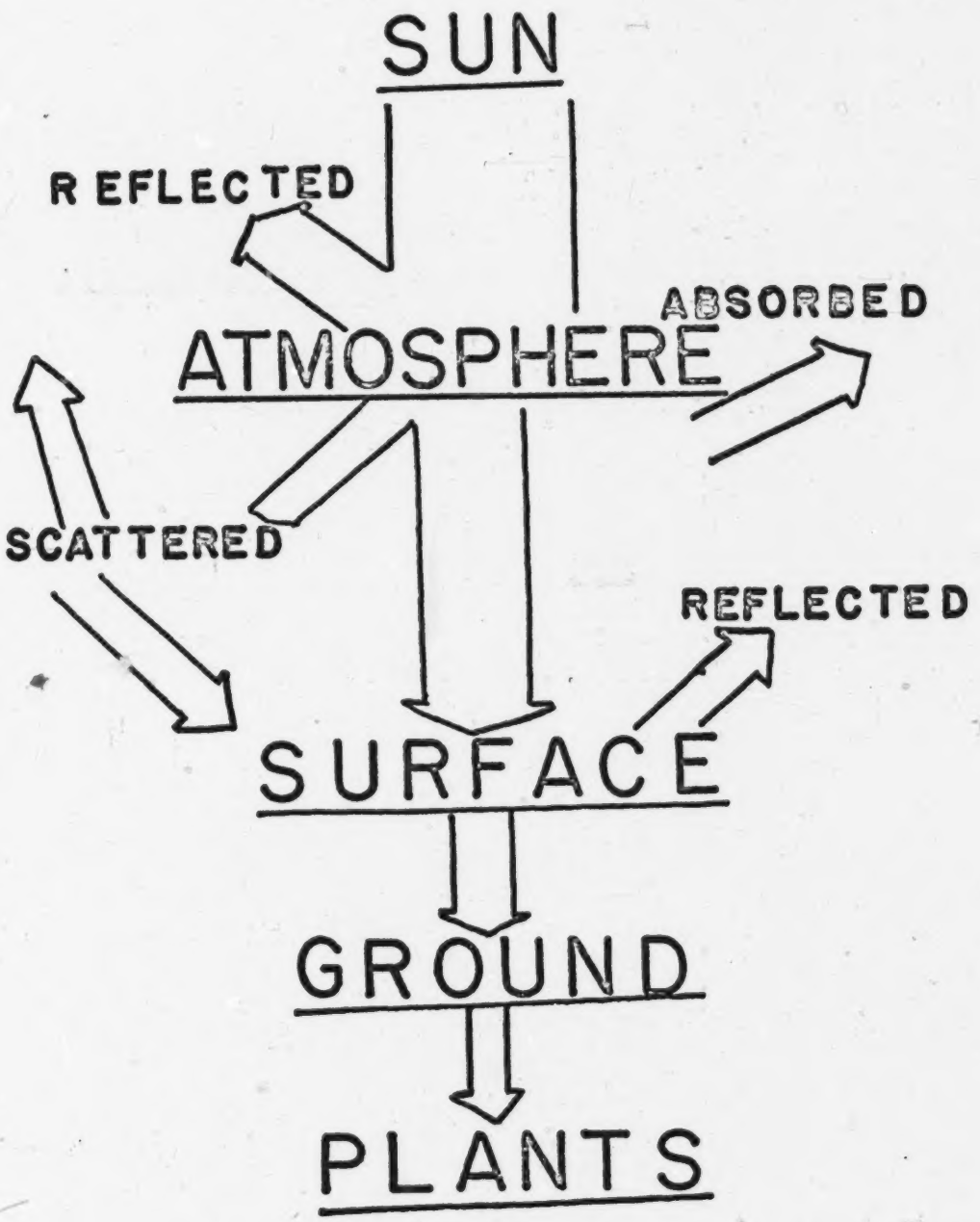
ENERGY LOSS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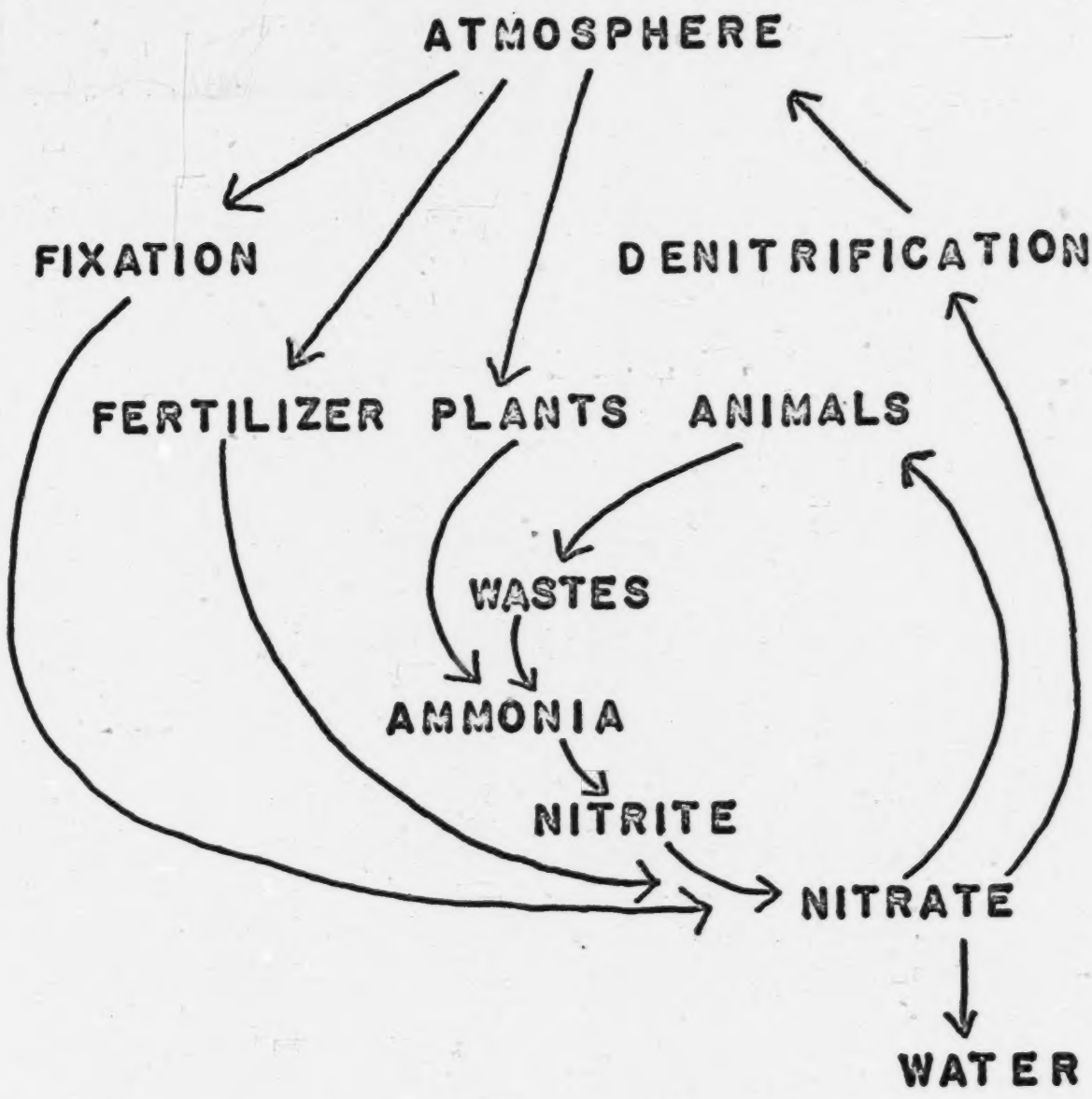
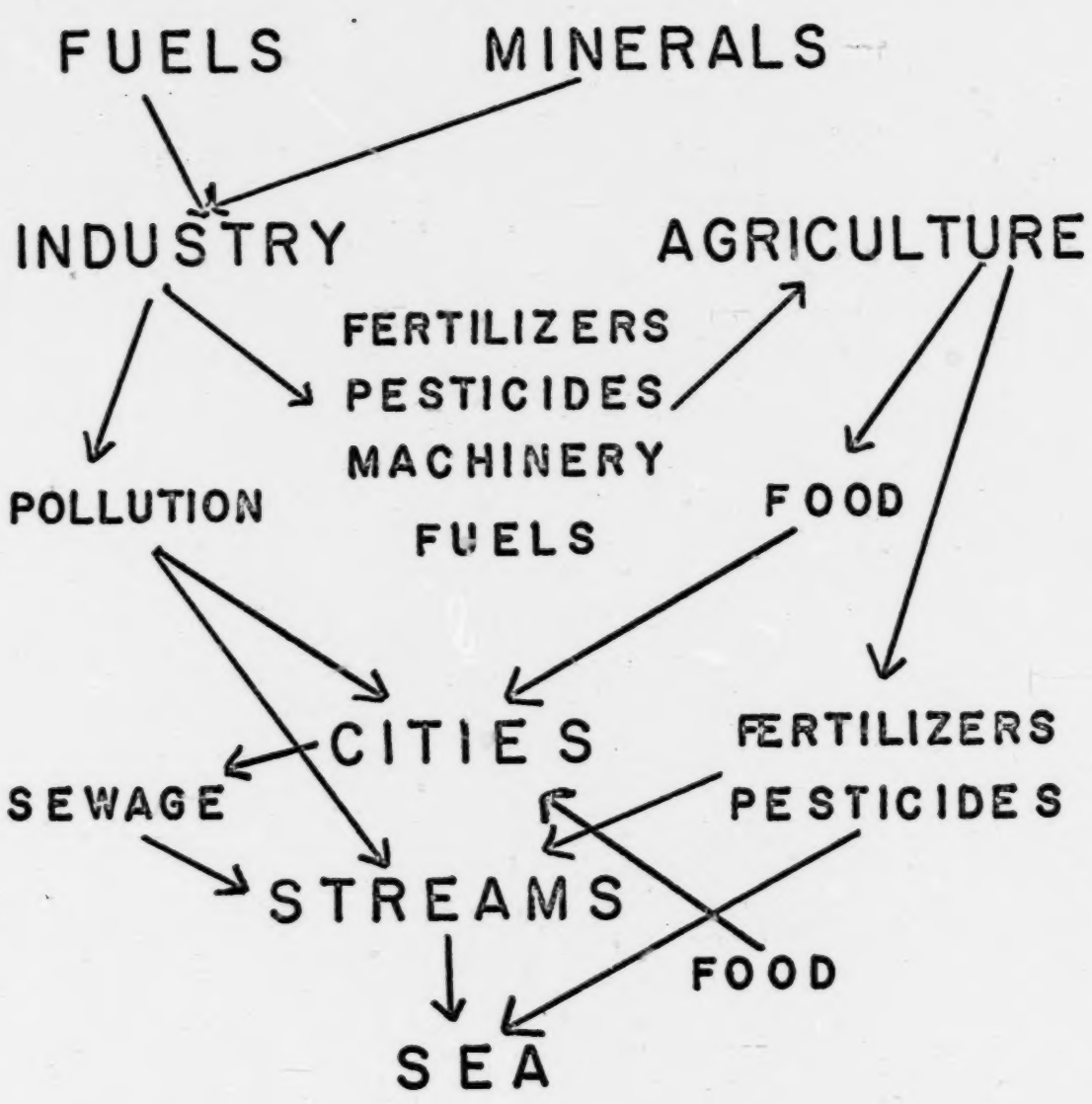
NITROGEN CYCLE

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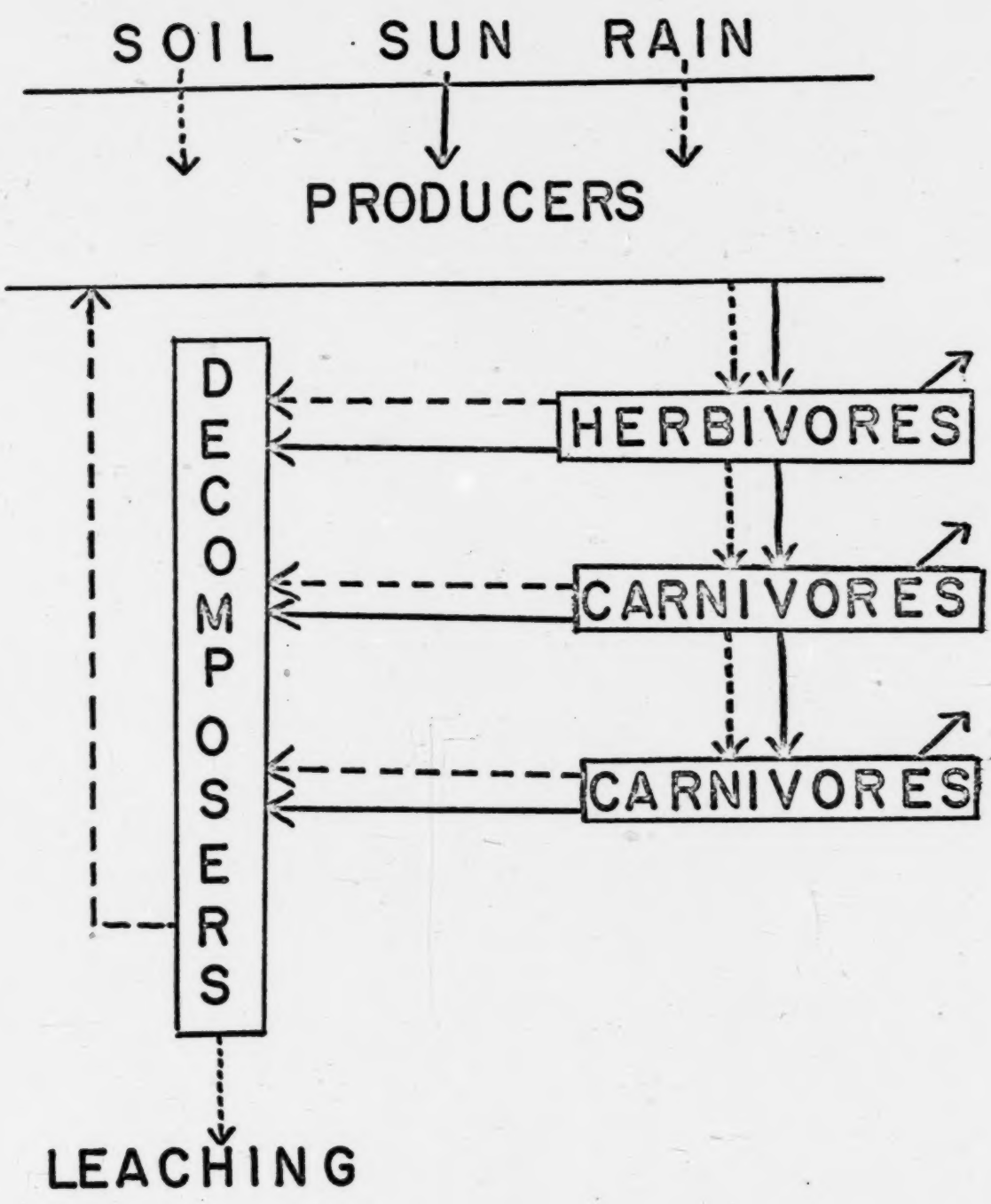
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PRODUCERS
DECOMPOSERS
HERBIVORES
CARNIVORES
CARNIVORES
LEACHING

UNIT: The Ecological System

LESSON: Land Use and Supply

INTRODUCTION:

The amount of available land is fixed. Land is one of the basic resources. There is a constant demand for land for various uses and consequently there is competition for the existing supply of land. Because there is a fixed supply of land, putting land to one use means it has been taken out of another use.

PURPOSE:

To develop a knowledge and understanding of the supply and use of land resources and the various factors which affect how land is used.

OBJECTIVES:

The student will be able to:

1. Define what the concept of land includes.
2. Name the ten major classifications of land use.
3. Discuss the factors that determine what land is used for and it's "value".

PRESENTATION:

What is land?

Sometimes land refers to a nation of people. Land is more than just soil and earth.

What other things go along with control of land?

Surface area: soil, water, ice, crops, and lakes

Trees and Forests

Buildings, Dams, and Terraces

Minerals

Water Resources

It also involves access to rain, sunlight, and natural occurrences. Land is the natural and man-made resources which possession of the earth's surface gives control of.

There are several other ways to look at land:

1. Space - the amount of land (space) is fixed.
2. Nature - the natural environment on land.
3. Production - it is needed to grow things.
4. Consumption - used up for buildings, forests, and parks.
5. Location - how far from cities, roads, and markets.
6. Property - rights of the person who owns the land.

What are the things we use land for and examples of each?

1. Residential - houses, garages
2. Industrial and Commercial - factories, stores, parking
3. Crop Land (tillable) - food production
4. Pasture and Grazing - tillable, permanent, range lands
5. Forests - commercial, brushland, farm woodlots
6. Minerals - coal mines, oil, iron, gravel
7. Recreation - mountains, parks, lakes, rivers
8. Transportation - airports, highways and roads, trains
9. Service - cemeteries, prisons, military bases
10. Barren and Waste - deserts, arctic regions

(Transparency 8)

These may be broken into four groups:

urban, agricultural, special use, and unused

Which of these is the largest group in the United States?

Agricultural - 87.0 percent

Urban - 1.4 percent

Special Use - 5.0 percent

Unused - 6.6 percent

Urban - 29.3 million acres

Crop land - 377.0 million acres

Pasture - 780.0 million acres

Forests - 732.0 million acres

Recreation - 59.9 million acres

Transportation - 26.0 million acres

Military - 23.6 million acres

TOTAL - 2266 million acres

Is more land in the United States in farms that not in farms?

No; only 49 percent of the land is now in farms.

What are some of the natural factors that determine what land is used for?

Sunlight and temperature

Precipitation and availability of water

Topography and drainage

Soils and minerals

Location

Which of these apply to the major land classification?

Agriculture - sunlight and temperature, precipitation, topography, and soils

Urban - location

Recreation - location

Mining - minerals and location

Transportation - topography and location

Service - topography and location

What other things determine what land is used for and it's value?

The demand for a certain piece of land by industry, agriculture, etc., determines what it will be used for. Whoever wants it the most will pay the highest price.

As the population increases, the demand for land increases.

The cost to develop the land, i.e. clearing.

Transportation

Technology - new developments which help make it more profitable to use the land for something.

Laws - such as EPA regulations, zoning

What is the purpose of zoning?

Zoning restricts the uses that land can be used for in a certain area. It can provide for such things as green belts which are housing free strips in housing districts to allow for recreation areas. Zoning can also prohibit housing spreading into fertile areas and restrict them to areas less valuable as farm land yet suitable for housing.

Which type of land classification usually has the highest value?

1. Commercial and industrial - they can afford to pay high prices to be located close to markets and transportation.

2. Residential - people will pay high prices for a small tract of land to call their own and build on. Developers can thus afford to pay high prices for land.

3. Cropland and pasture

4. Forests and grazing

5. Barren and waste

It should be realized that some land uses overlap each other. For example, some timber areas have value as recreation areas, as sources of forest products, and as grazing areas. The classification is based upon that use which the land is used for the most.

CLASS ACTIVITY:

As the population increases their will be a demand for more food, more houses which mean increased lumber demands, more businesses and industry, more recreation areas, more highways and airports, and more mining of natural resources. Since the amount of land we have is limited, how can we meet these increased demands for land?

Class Discussion

SUMMARY:

Definition of land

The ten classifications of land use

The factors which determine how land is used

SUGGESTED TEACHING AIDS:

Transparencies:

1. Land classification
2. Land use figures

BIBLIOGRAPHY:

1. Barlowe, Raleigh, Land Resource Economics, Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1972. Chapters 1 and 2.

2. Dasmann, Raymon F., Environmental Conservation, New York: John Wiley and Sons, Inc., 1968. Chapter 5.

LAND CLASSIFICATION

RESIDENTIAL

INDUSTRIAL & COMMERCIAL

CROPLAND

PASTURE

FOREST

MINERAL

RECREATION

TRANSPORTATION

SERVICE

WASTE

UNIT: The Ecological System

LESSON: Population Distribution and Growth

INTRODUCTION:

As the population increases there are also increases in the demands for goods and services, and in the problems of the society. As the population becomes more centered in densely populated urban areas there are many problems which must be dealt with on a wide scale.

PURPOSE:

To create an understanding of the implications of increased population and the associated problems.

OBJECTIVES:

The student will be able to:

1. Define the following terms: birth rate, mortality rate, replacement rate, and subsistence level.
2. Discuss what population density is and why it varies from location to location and country to country.
3. Discuss the problems associated with population growth.
4. Describe the effects of population growth on agriculture.
5. Discuss why the United States population grew so rapidly.

PRESENTATION:

What two things will determine population growth?

bith rate - number of babies born per 1000 people

mortality rate - deaths per 1000 people

The difference will be the growth rate.

United States - 1970

birth rate = 17.6

mortality = 9.6

1972 - averaged 2.04 children per couple

Replacement rate = 2.11

Show figures for other countries. (Transparency 9)

Define replacement rate -

The number of births required to maintain the population.

What are some of the factors that have influenced the population?

War

Famines - 600 occurred up to 1800

Disease - Black death reduced Europes population 20 percent.

The average life span in the middle ages was 24 years. It took 10-11 children per couple to maintain the population.

The life span in 1780 was 35, today it is 71. What factors have brought longer life spans?

Industrial Revolution - technology

Increased agricultural production

Sanitation improvements

Better medical knowledge

What do we mean by subsistence level?

providing the basic needs of food, clothing, and shelter

Why has this level gone up over time?

people's income has steadily gone up

people are better educated

technology has made many advances

customs have changed

society and culture have changed

The majority of people used to live on farms and raised most of their own food. This has greatly changed.

What is population density?

The average number of people in a given area, such as a square mile or square kilometer.

Examples are:

Belgium	317.9 people per square kilometer
Japan	279.9
U.S.	22.3
Australia	1.6

98 percent of Egypt's population is found on the 3 percent of the land along the Nile. Population density vaires greatly within countries.

New Jersey	453 people per square mile
Wyoming	3.4
Alaska	.53
Manhattan Island	67,160

What are some of the reasons that population densities vary from location to location?

1. Urban areas have grown up around large industry which is where the majority of the population lives.
2. It takes less people to produce food, thus these areas are less populated.
3. Climate - the warmer areas are more desirable.
4. Coastal areas - traditional trade centers.

Lets look at the United States population growth:

1800	5.3 million
1850	23.2
1900	76.2
1950	151.3
1970	204.0

Why has the United States population grown so rapidly.

1. Immigration - 45.2 million entered between 1830 and 1970.
2. Abundant resources and policies to develop them.
3. Relatively high birth rates.
4. Reduced mortality rates.

What problems do increasing populations cause? (Discuss)

1. Need for increased food production.
2. More housing.
3. More services: cities, highways, sewage.
4. Increased use of natural resources
5. More pollution and waste problems
6. All of these must take place on the same amount of land.

The United States has about 6 percent of the world's population yet it consumes around 40 percent of the world's production each year. Between birth and age 70, an American consumes approximately 56,000,000 gallons of water, 21,000 gallons of gasoline, 10,150 pounds of meat, 28,000 pounds of milk and cream, and 9,000 pounds of wheat.[4]

In what way does an increasing population affect agriculture?

1. The need for food production increases as the population increases. This means improvements in yields on the same amount of land must be developed.
2. Cities and urban areas expand and grow into areas which were previously agricultural lands. Thus land is taken out of production.

There are several characteristics of today's population:

1. Urbanization - more people live in cities than ever before.

2. Households - many more houses, smaller number per family.

3. Age - life expectancy is longer.

4. Education - more people are getting more education.

5. Income - has increased dramatically.

Per Capita (person) Income:

1929 - $1145

1940 - 1178

1950 - 1520

1960 - 1749

1970 - 2600

Families, especially farm families, used to be quite large. Why isn't this found today?

Farm families used to rely on the family members to work on the farm. Now machinery and technology have replaced much of the work formerly done by hand labor.

The world population is 3.6 billion (1970). Some of the countries with the higher population growth rates are Brazil, India, China, Nigeria, Pakistan, and Mexico. Why do these countries have such high population growth rates?

1. Many have large populations which normally lead to a more rapid population increase.

2. Are poor, underdeveloped countries with many uneducated, subsistence level people.

3. Much of the work is still done by hand labor.

4. There has been improvements in disease prevention, yet their birth rates have not dropped yet.

5. The people do not understand the consequences of a large population on their country and themselves.

In 1966 the United States sent one-fourth of it's wheat crop to India. Since then the world population has increased tremendously. If these countries, such as India, were to experience another widespread crop failure and drought, it is unlikely countries such as the United States could even begin to feed those people and their own too.

CLASS ACTIVITY:

The population of the animals in an ecosystem stay fairly constant or fluctuate somewhat together. What is the reason?

Weather, food supply, disease. (Discuss)

Why has the population of the world grown so steadily then?

Man has control and has solved many of these problems.

Discuss shelter, food production, sanitation, disease, and technology.

SUMMARY:

Definitions:

1. birth and mortality rate
2. replacement rates
3. subsistence level

Population density and variations of this

Problems of population growth

Effects on agriculture

U.S. population growth

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1. Barlowe, Raleigh, Land Resource Economics, Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1972. Chapter 3.
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3. The Institute of Ecology, Man in the Living Environment, Madison: The University of Wisconsin Press, 1972. Chapter 2.
4. Zero Population Growth, The Crisis.

BIRTH AND MORTALITY RATES[1]

COUNTRY	BIRTH	MORTALITY
BOLIVIA	44	20
CAMEROON	50	26
NEPAL	41	21
IRAN	48	15
MEXICO	44	10
BELGIUM	14.8	12.8
SWEDEN	14.3	10.4
U.S.	17.6	9.6

UNIT: The Ecological System

LESSON: The Energy Crisis

INTRODUCTION:

The world's use of energy has rapidly increased in the past decade and consumption and demand is expected to continue to rise. The supply of energy sources is limited and some are beginning to fall behind the demand. Thus there is a constant investigation for new sources and supplies of energy to guarantee the availability of energy for future generations.

PURPOSE:

To develop an understanding of the problems facing the world in regard to energy supplies and some of the alternatives to the current energy sources.

OBJECTIVES:

The student will be able to:

1. Discuss why the use of energy has increased so rapidly.
2. Explain why the U.S. uses so much and why the world use will greatly expand in the future.
3. Describe future sources of energy and problems of each.
4. Discuss how agriculture is dependent upon energy supplies.

PRESENTATION:

What are our primary sources of energy today?

coal, oil, natural gas, water power = electricity

(Transparency 10)

Where are these sources of energy used?

1. heating
2. electric power
3. engines
4. industrial processes

What are some of the problems in supplying the energy needs of the United States?

1. The consumption of energy continues to increase.
2. Supplies are harder to develop and recover.
3. Pollution standards reduce the use of some.
4. Refining of oil has not developed as fast as use.

Why has the consumption of energy continued to increase so rapidly?

1. Population has increased.
2. People own more cars and drive them much more.
3. Industry has expanded.
4. The consumption of electricity has increased.
5. More houses to heat and cool.
6. Transportation of products has grown.
7. Mechanized agriculture uses more.

The big problem with all energy sources is that they are nonrenewable. They are lost once they are used.

The use of energy in this country doubled from World War II to 1970. Since 1900 our population has increased over two and a half times, yet our energy consumption has increased more than seven times. This is over twice as fast as the population growth.

It has been estimated that the United States will use over one-third more energy by 1980 than it did in 1970. This will see much more emphasis placed upon atomic energy to supply needed increases as the supply of petroleum products becomes more and more critical.

There has been a shift during this century from coal as an energy source to petroleum and gas. The future will undoubtedly see another shift to nuclear and possibly a slight increase in the use of coal as petroleum supplies decrease.

The Bureau of Mines has predicted the increases in energy consumption from 1980 to 2000.[4]

Total Energy	+90 percent
Petroleum (Oil)	+51
Gas	+58
Coal	+11
Nuclear Energy	+1000

The United States uses 32 percent of the world's energy consumption, about 1/4 barrel of oil per person per day. Other countries such as Australia, Belguim, Canada, France, England, and the Soviet Union have high levels of consumption. Why do these countries use so much more energy than the others?

These are the developed countries of the world and are thus highly industrialized. The people use more goods and have more money to purchase products. Because they are industrialized they produce many of the goods for other countries. The underdeveloped countries concentrate on food production, have few cars and trucks, and have little industry.

India consumes less than two percent the per capita consumption of the United States.

Brazil consumes three percent.

Haiti and Nigeria consumes .3 percent.

Why will the need for energy greatly expand in the future?

As many of the underdeveloped countries begin to develop and industrialize they will require vast amounts of energy. Energy is the key to a growing and industrial nation.

Let's look at the supplies of our current energy sources.

Coal - one source estimates there are more than 1.6 trillion tons of coal available in veins thick enough to mine. This is sixty times the total amount mined so far. But costs to recover are increasing and the pollution problems must be met.

Oil and Gas - the supply of these is much more limited. The consumption of these products is far exceeding any new discoveries in this country. Known reserves only exceed use by a few years.

Atomic Energy - with the use of breeder reactors which consume very little fuel, there is an adequate supply of atomic fuels. One problem is in finding large enough levels to warrant mining.

The supply of coal is still relatively large. Oil is one of the most critical. What are some of the possible sources of future oil supplies?

1. Oceans
2. Arctic areas
3. Middle East
4. Underdeveloped countries

What are some of the problems in finding additional supplies of oil and coal supplies?

1. costs to recover the supplies
2. relations with foreign countries
3. transportation
4. location: ocean and arctic areas

In what ways are agriculture dependent upon energy?

Agriculture has become more and more mechanized. Fuel is needed in large quantities to operate tractors. Many of the jobs that were formerly done by labor are now mechanized. An example of this would be mechanized feed lots. Agriculture uses tremendous amounts of fuel in grain drying and transportation of products as well as an increasing amount of electricity in livestock operations. Processing of agricultural products also depends on a supply of energy.

Several new sources of energy are expected to be developed for future use. Several are:

1. gas developed from coal
2. nuclear energy
3. solar energy
4. the tides

Nuclear energy will become the most used. Therefore, we must look at the possibilities of running out of fuel sources for nuclear power. With improved methods of nuclear generating plants, the supply of uranium will last a long time.

With the use of hydrogen to generate nuclear energy, the water of the oceans could be used.

A source of energy for the future will not be as big a problem as the cost to develop methods of production. Technology will play a big role. Coal will continue to be used extensively, but more for the production of gas and oil. Nuclear energy will be about the sole source of energy for the production of electricity.

CLASS ACTIVITY:

In what ways can we help conserve energy?

Discuss: gasoline, electricity, heating fuel

SUMMARY:

Why energy use has increased and will continue to

Future places for exploration

Alternative sources

Agriculture's use

SUGGESTED TEACHING AIDS:

Transparency of energy sources

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3. Deju, Raul A.; Bhappu, Roshan B.; Evans, George C.; and Baez, Armando P., The Environment and Its Resources, New York: Gordon and Breach, Science Publishers, 1972. Chapter 5.

4. McNall, P. E., and Kircher, Harry B., Our Natural Resources, Danville, Illinois: The Interstate Printers and Publishers,

ENERGY USE

YEAR	COAL	OIL	GAS	TOTAL MINERALS	WATER	NUCLEAR
1900	89	5	3	97	3	-
1910	85	8	4	97	3	-
1920	80	12	4	96	4	-
1930	63	24	10	97	3	-
1940	53	31	12	96	4	-
1950	42	33	20	95	5	-
1960	24	44	28	96	4	-
1970	23	42	30	95	3	2

(U.S. Bureau of Mines; Information Bulletin 8384, 1970)

UNIT: The Ecological System

LESSON: Natural Resources

INTRODUCTION:

Most of the things which man uses and enjoys are a result of our vast natural resources. Today there is a growing concern for the conservation and wise use of our natural resources. They are defined as those materials supplied by nature which are useful to mankind.

PURPOSE:

To become aware of the types and kinds of natural resources and to discuss areas of concern in their use and management.

OBJECTIVES:

The student will be able to:

1. Define and give examples of inexhaustible, replaceable, and irreplaceable resources.
2. Discuss the value of wildlife and soil as natural resources.
3. Discuss the factors which influence the value of resources.
4. Define and give examples of metallic and nonmetallic metals.

PRESENTATION:

Natural resources are often categorized as renewable and nonrenewable. Another way is to classify them as inexhaustible and exhaustible.

What is an inexhaustible resource and some examples?

These are resources which are constantly being renewed and replenished. The three main examples are the sun's radiant energy, which is constantly renewed by the sun; the

atmosphere, which is constantly being renewed; and our water resource. Water is replenished through the action of the hydrologic cycle. (Transparency 11)

These three resources would also be classified as renewable, since they are constantly being replaced and renewed.

What effect might the pollution of our air and water have on the atmosphere and water resource as inexhaustible resources?

If they become too polluted and contaminated their usefulness may become more limited. We are not so concerned with the quantity of these resources as we are with the quality of the air and water. Air and water are essential to all but a few microscopic organisms for survival. A cornfield requires more than 1000 tons of water per acre to give an average yield.

Define exhaustible resources:

These are resources which are available from a limited supply. There are two types of exhaustible resources: irreplaceable and replaceable.

What are replaceable resources?

These are resources that can be replaced or renewed after they have been used up. Examples are forests and wildlife. These would also be classified as renewable resources.

How is a forest a replaceable or renewable resource?

Whether left in their natural state or managed for their timber sources, forests will renew and maintain themselves. Naturally this is a very slow process, but forestry practices help to speed it up. This is especially evident after a forest fire.

A forest also serves as a watershed and helps to preserve and maintain the soil.

What about wildlife?

With proper management wildlife will multiply and continue to maintain itself, just as it would in a natural, balanced ecosystem. When unmanaged, wildlife can near extinction and may reach a point where it is difficult to preserve the species and continue to renew it.

Of what value is wildlife as a resource?

Some industries are dependent upon wildlife resources. Examples are the fish industry and the wild fur industry.

Hunting and fishing provide recreation and pleasure to thousands of people each year. This has become even more popular as urban people spend more leisure time in the outdoors. Wildlife also has purely recreational value to many people.

What are irreplaceable resources?

These are resources which cannot be replaced or renewed once they have been used up. Minerals such as iron, copper, and potash are examples as are coal, oil, and gas. Once they have been mined and used they are not renewed or replaced. Thus alternatives must be found when these are used up.

What are some of these alternatives?

The depletion of minerals can be slowed down through the recycling process. In this way the actual consumption is reduced, although some loss still occurs.

Plastics and synthetic materials can replace many of the ways minerals are used.

The energy forms must be replaced by new forms of energy.

Under what classification would soil fall?

Soil can be classified as replaceable or as irreplaceable. Once soil has been eroded away it is lost and the time it takes to renew it is very long. One estimate is that it takes two thousand years to make an inch of soil from the earth's rock. So for all practical purposes soil is an irreplaceable resource. This is why much emphasis should be placed upon soil conservation.

Soil is very essential because it provides the growth medium for plants, containing the nutrients and water needed for plant growth. Plants are the basis for food production.

Minerals can be broken into two types: metallic and non-metallic.

Define and give examples of each:

Metallic minerals - These are the metals which are commonly thought of when speaking of minerals. Examples are iron, aluminum, copper, nickel, tin, and gold.

Non-metallic minerals - These include the fossil fuels such as oil and coal; building materials such as cement, sand, and gypsum; and chemicals like sulfur, potash, phosphate, and sodium chloride. (Transparency 12)

What determines the value of a resource?

1. Abundance - Air is an essential resource but because it is inexhaustible it is considered a free resource. This may be changed somewhat in areas which are continually hampered by air pollution.

2. Demand - This goes along with how large the supply is. If there is little demand for a resource, it has little value. However, if there is a large demand and a limited abundance, it will rise in value. This is true of forest products.

3. Cost to recover - The higher the cost to mine or recover a resource, the higher will be the price of that resource. Examples of this are deep oil wells versus shallow wells and the harvesting of timber reserves deeper in the forests.

These three factors plus others all interact to determine the value of a resource. Other factors will include the purity of the resource and transportation changes.

CLASS ACTIVITY:

The United States has mined and consumed large quantities of natural resources in the past. Many of these practices have greatly affected our environment. Discuss some of these and how they might be improved.

Discussion might include strip mining of coal, the burning off of natural gas at oil wells, and the discarding of mine wastes with low ore content.

SUMMARY:

Inexhaustible and exhaustible resources

Wildlife and soil as natural resources

Alternatives to current resources

Metallic and non-metallic minerals

SUGGESTED TEACHING AIDS:

Transparencies:

1. Hydrologic cycle
2. Types of mineral resources
3. Categories of natural resources and examples of each

BIBLIOGRAPHY:

1. Allen, Shirley Walter and Leonard, Justin Wilkinson, Conserving Natural Resources, New York: McGraw-Hill Book Company, 1966.

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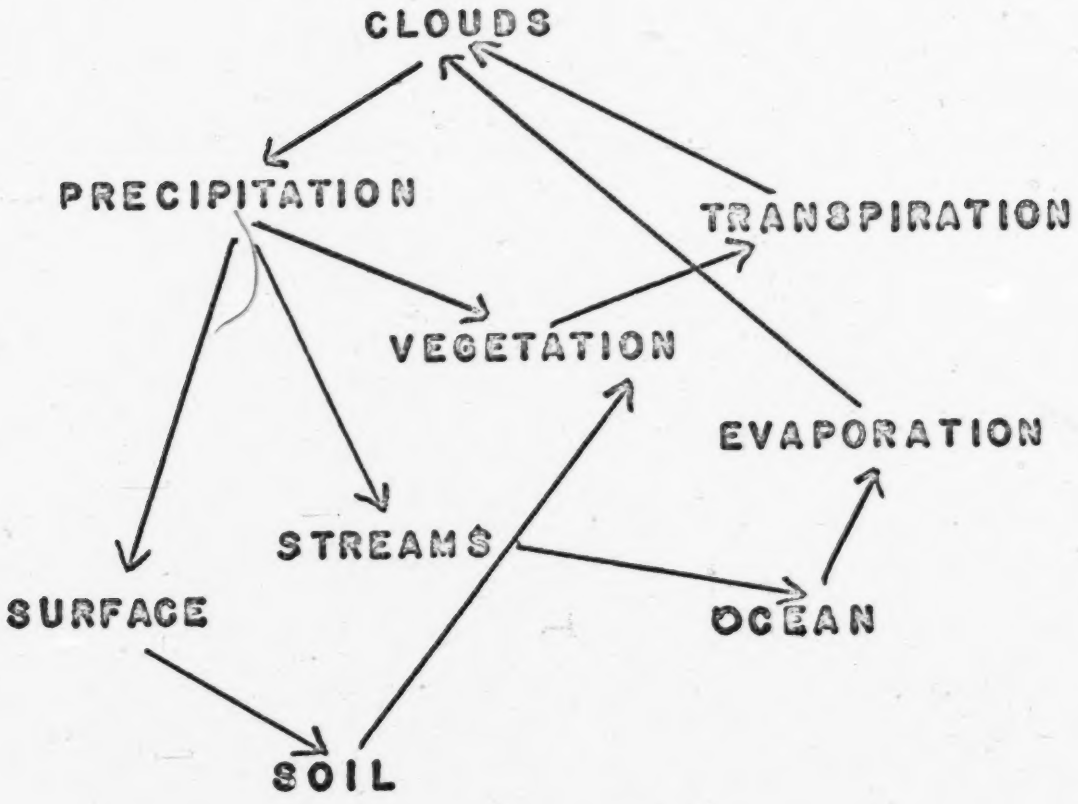
THE HYDROLOGIC CYCLE



MINERAL RESOURCES

METALLIC

Abundant:

- Iron
- Aluminum
- Magnesium

Scarce:

- Copper
- Zinc
- Gold

NON-METALLIC

Fertilizers:

- Nitrogen
- Phosphorous
- Sulfur

Building Materials:

- Cement
- Sand
- Gypsom

Fossil Fuels:

- Coal
- Oil
- Gas

UNIT: The Ecological System

LESSON: Food Production and Supplies

INTRODUCTION:

Food is one of the basic essentials to the world population. As the population continues to rise, there is increased pressure on existing lands to produce more food. Even today in many countries people are on the edge of starvation while their population continues to grow at a rapid pace.

PURPOSE:

To discuss the problems of increasing the level of food production and some of the solutions to meeting future food requirements.

OBJECTIVES:

The student will be able to:

1. Discuss the reasons why food production has increased rapidly in some countries but not others.
2. Describe the effects of food production on the environment.
3. List the problems associated with the use of the ocean resources as sources of food.

PRESENTATION:

Why do the more underdeveloped, less industrialized countries have more problems in producing enough food?

1. Since they are less industrialized, they have very little modern machinery and equipment.
2. Many of the countries have fairly high levels of population growth.
3. The majority of their population still live in rural areas, producing food on small plots.
4. Much of their population cannot read or write.

5. Modern practices of fertilizing and using chemicals and pesticides have not been developed.

6. They have not adopted the use of improved crop varieties and disease resistant varieties.

7. Soil conserving practices and crop rotation practices are not used.

8. Because they must devote so much of their land and evergy to food production, they have not been able to develop industrially.

Why have the more industrialized countries such as the United States been able to increase food production with population growth?

1. Population growth is smaller.

2. Large, intense farming units.

3. Use of technological developments.

What are some of the technological developments and how have they helped food production?

1. Modern machinery - takes less man-hours of labor to work an acre of land.

2. Fertilizers - greatly improve yields.

3. New varieties - increased yields and disease resistance.

4. Pesticides - decreased losses due to weeds and insects.

5. Improved breeds - better livestock performance.

6. Improved rations - better growth rates in livestock.

In what ways can we increase the production of food to meet future needs?

Technology will play a big role. We will have to initiate new ideas and developments, especially in those countries far behind in modern agricultural practices. More intense use of the land will probably be seen and increased use of fertilizers and pesticides.

Underdeveloped countries will have to use modern practices and adopt high yielding varieties.

Discuss the various effects of food production on the environment and how they affect it.

Fertilizers - The main concern is with nitrogen and phosphorous contaminating water supplies. They can cause excessive algae growth which may destroy its value for drinking and use up the oxygen essential for fish.

Nitrates in drinking water can be toxic to babies. Fertilizers are only one of the many sources of nitrogen and phosphorous in water supplies.

Pesticides - Benefits of their use have far out weighed their harmful effects. In excessive quantities they can be harmful to wildlife and to people consuming products treated with pesticides.

Animal waste - Small feedlots have few problems, but large, intense operations may experience more problems. What are some of these problems?

1. odors from excessive manure

2. runoff polluting streams

3. breeding grounds for disease

Many methods are in use and are being developed to dispose of large quantities of manure.

The requirements of additional food production will conflict with some of the ideas of environmentalists. This will mean that new methods will have to be developed and the use of modern, up-to-date practices continued.

What is a possible alternative as a source of additional food supplies?

The ocean

What might some of the problems be with harvesting food from the ocean in large quantities?

1. throw the ocean life out of balance

2. need to develop harvesting methods

3. would have to change the eating habits of the people

The ocean has a tremendous potential as a future source of food. There is always the problem of managing the resources of the oceans because of the many countries who use them. This has already been seen in the depletion of many areas of fish and shellfish.

CLASS ACTIVITY:

History has seen the world stircken with many crop failures and the resulting famines. In 1967 India suffered a famine and starvation is still found in many countries. Does the possibility of a famine exist today? Why is starvation still found in some countries?

SUMMARY:

The methods of increasing food production.

The effects on the environment of food production.

The problems associated with using ocean food resources.

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4. Walker, Robert D., How Food Production Affects the Environment, Urbana: University of Illinois, Cooperative Extension Service Circular 1037, 1971.

UNIT: The Ecological System

LESSON: Current Events Concerning Our Ecological System

INTRODUCTION:

New developments are constantly occuring which affect our environment. These may have positive or negative effects on it.

PURPOSE:

To develop an awareness of current events which may influence the situation of our environment.

OBJECTIVES:

The student will be able to:

1. Interpret the effect which current events in various subject areas may have on the environment.
2. Report to the class the importance of a recent development or event and its potential effects.

PRESENTATION:

Each student will be asked to prepare for a presentation to the class. This should be a report on a recent event or news article concerned with a topic involving the environment and/or some aspects of the following subjects:

Population

Food Production

Energy Supply

Natural Resources

Agriclture's Influence

Land Use

Other

The report should consist of an explanation of the article or event reviewed, the consequences of the event, and the students personal views. A brief discussion by the class will follow.

If the class is too large to give each student enough time, two days may be required or half the students could make reports at a later time during the study of other areas.